NUMERICAL INVESTIGATIONS OF GLS AND GGLS FOR ACOUSTICS

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Stabilized finite element methods improve the numerical performance of standard Galerkin approximations with low-order piecewise polynomials, which fail to attain high coarse-mesh accuracy for acoustic computations. Of the numerous approaches to alleviating this deficiency that have been proposed, least-squares stabilization stands out by combining substantial improvement in performance with extremely simple implementation.

The original development of the Galerkin-gradient/least-squares (GGLS) method was specifically directed to related linear reaction-diffusion problems [1]. It was later shown that the Galerkin/least-squares (GLS) method, which preceded GGLS as a general methodology [2], can also alleviate instabilities in acoustics problems [3]. Both methods are quite similar for linear finite elements. In fact, GLS and GGLS produce *identical* solutions on structured meshes of linear elements (for constant-coefficient Dirichlet problems with uniform source distributions).

The performance of the two methods can be compared analytically only in those simple configurations in which they produce identical solutions. Comparisons in more general configurations must be performed numerically. We report on the results of a series of numerical tests which compare GLS and GGLS for several configurations with different kinds of boundary conditions employing structured and unstructured meshes. Various definitions of the resolution-dependent stability parameters are considered, along with different definitions of the mesh size upon which they depend.

References

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